Site Characteristics of Southern Utah Sites for Astronomical Observatories

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Abstract. The University of Utah has recently begun construction of a new 0.8m optical/IR robotic telescope to be operated as a regional astronomy resource in the Intermountain West. The new Southern Utah Observatory (SUO) will require a high altitude (>3000 m) site with excellent atmospheric seeing, favorable weather conditions, and nearby infrastructure, including road, power, and high speed internet. We have explored six possible sites for the SUO telescope with favorable climate, night sky darkness and infrastructure. Since spring 2007, we have performed detailed measurements of atmospheric seeing at several of these sites, and have identified the preferred site for the SUO telescope at Frisco Peak, UT. Several large (1 sq. mile) areas of State Trust Land are nearby the new SUO telescope site. These large, flat areas may be excellent sites for large area, next generation Imaging Atmospheric Cherenkov Telescopes (IACT) arrays such as AGIS or northern CTA.

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SITE LOCATIONS

In 1984, Lynds and Goad [1] published a study of possible locations of new observatories in the Intermountain West. Utah sites with favorable weather patterns, mountain profile, and high altitude were considered in this study; many of these sites were found to be of comparable or better quality to Kitt Peak, Mt. Hopkins,and Mt. Graham in Southern Arizona. We have selected favorable Utah sites from this study as well as several new sites in Central Utah for consideration in this study. Sites were selected with existing road access, high altitudes, and with favorable weather. Six sites (Figure 1) were visited and measured for atmospheric seeing from June 2007 - July 2008.

INFRASTRUCTURE

Infrastructure is a prime consideration for the new SUO telescope. All six sites considered provide an observatory location above 2900 m, with access using an existing road. Only the Frisco Peak site has existing power, and existing internet connectivity (multiple OC3). The remaining five sites would have to use a radio or line-of-sight microwave to state telecommunication network for internet access.

Telescope site locations are generally equidistant between Salt Lake City, UT and Las Vegas, NV. Typical travel time from international airport is 4 hours. All sites have nearby towns (< 30 minutes) for hotel, gas, grocery, hardware store, concrete plants, crane service, and other necessities.

SITE SELECTION & FUTURE LARGE IACT ARRAY

We have selected Frisco Peak site (38.5 N, 2940 m a.s.l, Figures 2 & 3) since it was found to have the best weather conditions, the best atmospheric seeing and the best infrastructure. The site was listed in the 1984 Lynds and Goad survey[1] as being one of the better choices for a new astronomical observatory, with seeing conditions for Visible/IR astronomy superior to Kitt Peak, Mt. Hopkins, and Mt. Graham. In closing, we note the availability of several large area (1 square mile, 2000m+ a.s.l) sections of State Trust Land to the east of Frisco Peak which are suitable for deployment of a future Large IACT array like CTA/AGIS. The SUO telescope first light is scheduled for Sept 2009.

NIGHT SKY DARKNESS & ATMOSPHERIC SEEING

Night Sky darkness measurements in Central Utah near all six sites have shown V-band darkness better than 22^{nd} mag/sq arc sec[2]. V band atmospheric seeing was measured using an automated solar-powered SBIG atmospheric seeing monitor, controlled by a 10 W mini-computer and cell-phone modem. The CCD-based measurement system measures the atmospheric seeing quality by fitting the 2-D blur spot of Polaris as a function of

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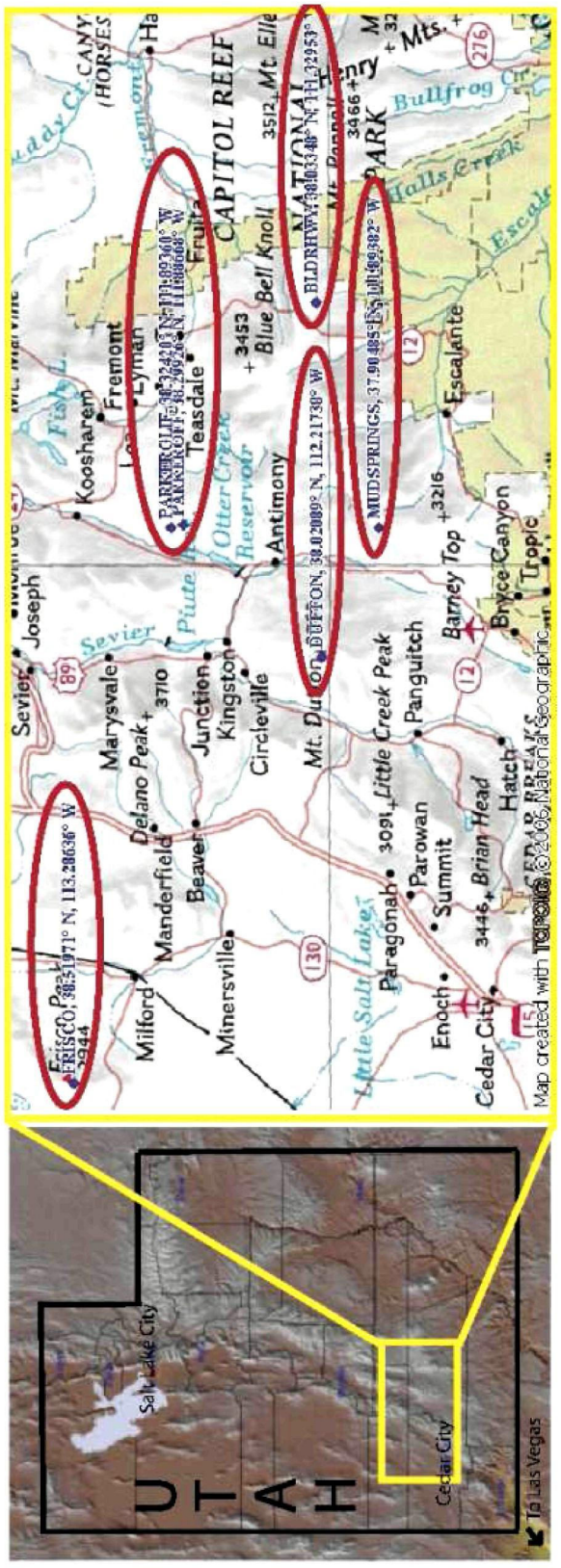


FIGURE 1. Location of the SUO sites studied in Southern Utah. The individual circles indicate the coordinates of the candidate sites.

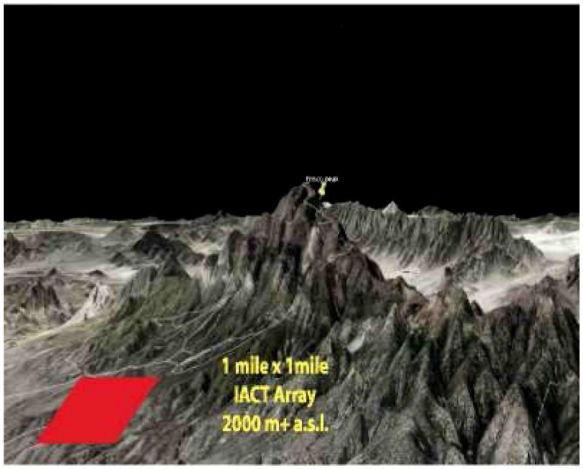


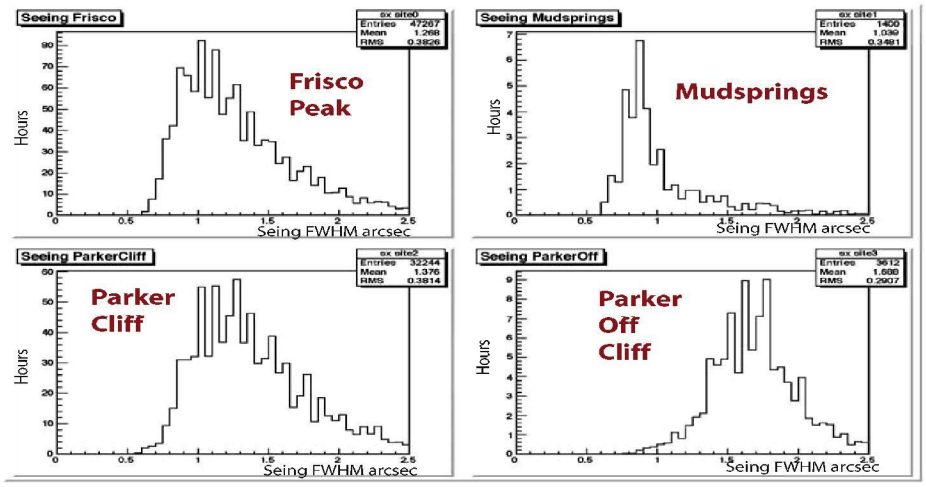
FIGURE 2. Frisco Peak topology. A potential site for a future large IACT array site is marked in red.

FIGURE 3. West-East Elevation profile around the Frisco Peak Site. Possible locations of potential future large IACT array are indicated with arrows.

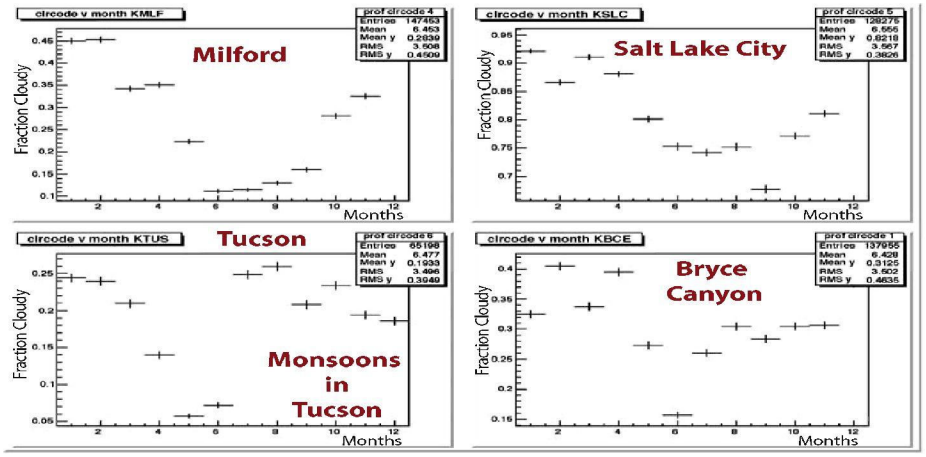
time (Figure 5). Figure 4(a) histograms the distribution of observed seeing over several months at various sites. The Frisco Peak site showed the best seeing of all the sites. On many nights the V-band seeing at Frisco Peak was 0.7-0.8 arc-seconds during much of the night (Figure 5).

WEATHER PATTERNS

Historical weather data indicates a general decrease in precipitation in Utah as one moves west and south. Figure 6 indicates that Frisco Peak receives 50% less precipitation per year than the other five Utah sites. Figure 4(a) illustrates the number of clear sky days (from MESONET) for the Frisco Peak (Milford) site compared to Salt Lake City, Bryce Canyon, and Tucson. Figure 4(b) compiles the same data as function of month of the year. The Frisco Peak site has a similar number of clear sky days as southern AZ, but without the summer monsoon season. The number of clear nights reported by the



(a)



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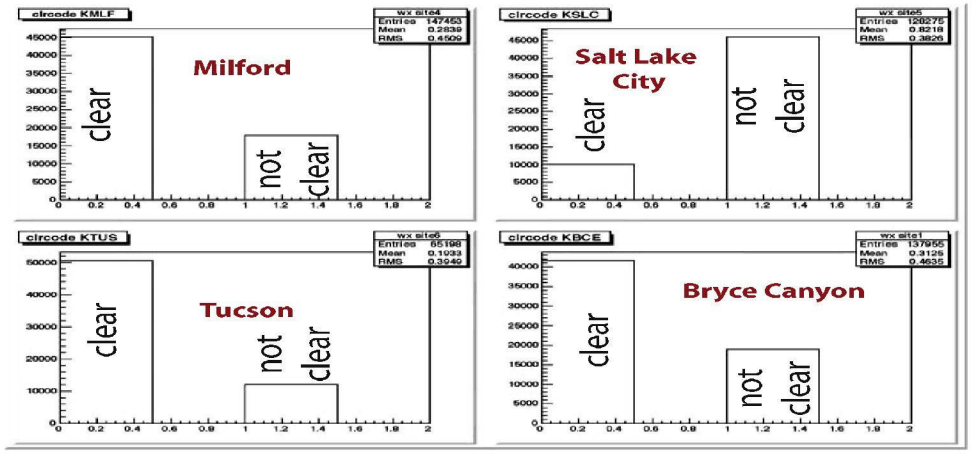

(c)

FIGURE 4. (a) Atmospheric seeing at several sites in Utah, (b) fractional monthly cloudy nights, Milford's (Frisco Peak) maximum is in February at about 45% cloudy, Salt Lake City's maximum is in January at about 92% cloudy, Tucson's maximum is in August (due to the seasonal monsoons) at about 27% cloudy, and Bryce Canyon's maximum is in February at about 42% cloudy. (c) Ratio of yearly clear nights.

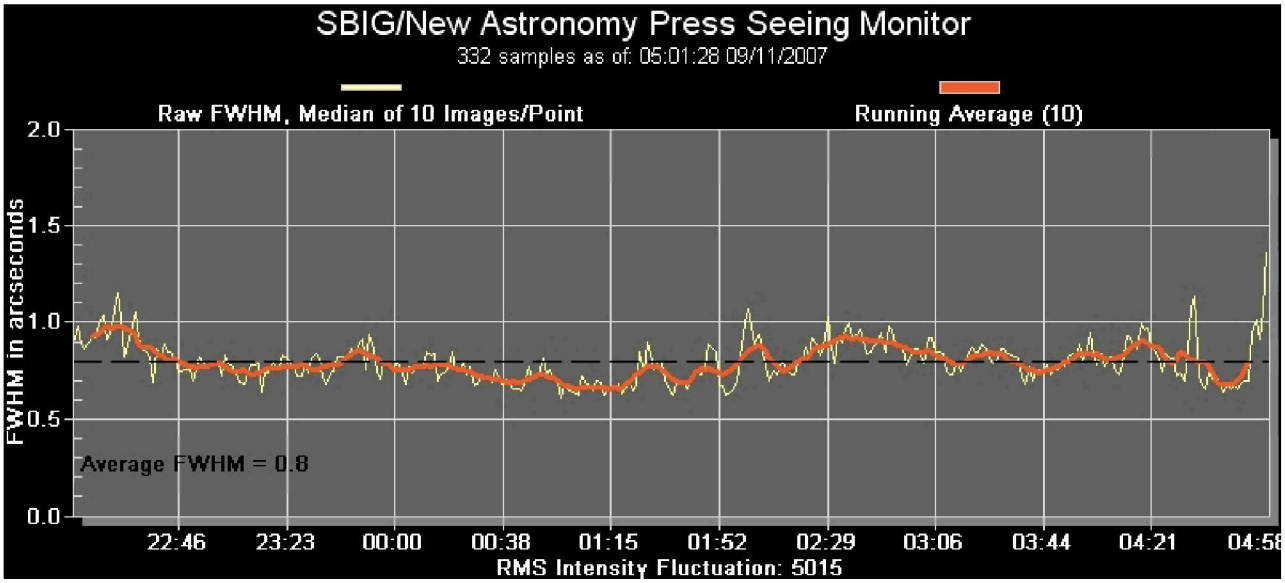

FIGURE 5. Measurement of V band seeing stability at Frisco Peak for a typical sub arc-second evening. The measurements were made using an automated SBIG polaris seeing monitor.

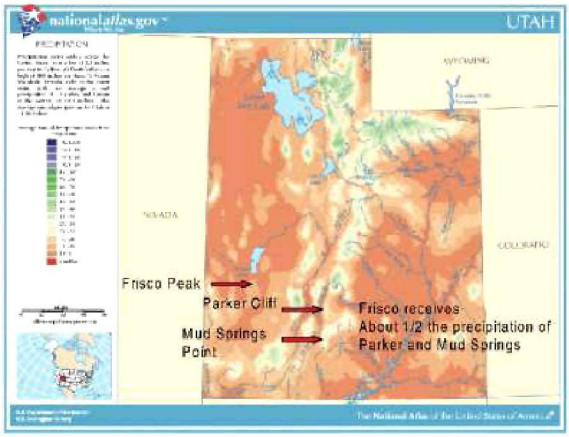

FIGURE 6. Average Utah Precipitation from the NationalAtlas.gov website. Dark areas have less average yearly precipitation

CELT's [3] five year satellite survey showed similar results as from the MESONET network.

ACKNOWLEDGMENTS

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